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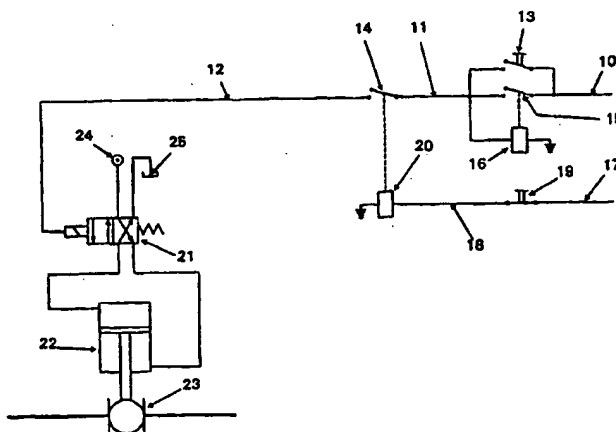
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(54) Title: CONTROL CIRCUIT



(57) Abstract

A control circuit for controlling a combined emergency shutdown and process protection (safety) system, especially on board platforms and vessels. There are two separate signal generators which, each by means of a control line (10, 17) of its own, can give release or control signals for operating a control valve (21) for the supply of hydraulic or pneumatic pressure medium for coupling a main valve (23) by means of an actuator (22). In order to, that one of the two control signal circuits should be capable of being operated independently on the operating condition and possible error conditions in the other, the control circuit comprises at least two separate connection branches (11, 18) for coupling to a common control line (12) to the control valve (21). The other of the two separate connection branches (18) includes an activating member (20), such as a relay, for a switch (14) adapted to connect the first connection branch (11) to the outgoing control line (12). An input signal on the first connection branch is coupled as an output signal to the control line (12) when a voltage is forced on the activating member (20).

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## CONTROL CIRCUIT

The invention relates to a control circuit for controlling a hydraulically or pneumatically activated valve in a process system, and which comes within the Norwegian Petroleum Directorate's "Regulations for security and communication systems on devices in the petroleum activity" or corresponding regulations. Such a control circuit is described in the preamble of claim 1.

The Norwegian Petroleum Directorate (NPD) has prepared security rules for systems to be included in the petroleum activity. In regulations concerning "Security and communication systems on devices in the petroleum activity", laid down on February 7th, 1992, paragraph 18, it is i.a. required that "Devices having equipment containing hydrocarbons must have an emergency shutdown system. The system should have a high reliability." It is further stated that "components included in the system have to be independent on and, additionally, to other systems. The emergency shutdown system may additionally be used as a process safety valve. The system should not to be influenced negatively through errors in other systems." It appears from this and other parts of the regulations that signals for emergency shutdown and process protection must proceed to the local control circuit independent on each other. Nevertheless, the two systems may use the same actuator, usually a hydraulic or pneumatic cylinder, which e.g. rotates a ball valve when the product flow has to be shut down.

Therefore, the two systems must meet, and this should take place in a way that secures that no errors in the part of the system belonging to the process safety system can have negative consequences for the reliability of the emergency shutdown system.

In the control circuit where the electrical signal is converted into hydraulic or pneumatic pressure, it is usual that separate hydraulic or pneumatic valves are mounted for the emergency shutdown system, other valves being mounted for the process safety system. Therefore, the two signals meet in the hydraulic or pneumatic part of the system, not in the electrical part. Such combined control circuits are well known, and there exist numerous designs thereof in use on oil platforms and in process systems on shore.

However, existing control circuits are burdened with substantial disadvantages. They comprise many components, causing a significant need for maintenance. Additionally, they are designed such that the two signals do not reach the actuator, independent on each other. This is a consequence of a hardly known problem linked to the hydraulic or pneumatic control valves: When a valve switches from one condition to another, the connection between some gates in the valve is opened, simultaneously as other connections are broken. This happens in a sequence determined by the way the valve is constructed. In some valves, all valve gates are briefly short-circuited in the switching moment. Other control valves close all gates when they switch. There also exist valves which open some gates and close others while they are in the process of switching. What kind of error condition that might occur if the control valve get stuck while it is in the process of switching, depends on how it is constructed. In this connection, it is of interest that all known hydraulic and pneumatic valves pass through intermediate conditions while switching. Therefore, contrary to what one previously has believed, one can not carry out security studies of control

circuits through studying the hydraulics symbol applying to the control valve while it is in a completely switched position, analyzing the error possibilities on the basis thereof. When analyses are conducted correctly, one sees that higher reliability is not achieved through the use of more control valves than when using only one.

The main object of the invention is to provide a control circuit acting combinedly on emergency shutdown and process safety, and which may be made simpler and cheaper and, thus, more maintenance-friendly and reliable than known control circuits. The emergency shutdown system must act entirely independent on the process safety system, independent on what kind of hydraulic or pneumatic valve being used.

According to the invention, this is achieved through designing the control system as defined in the characterizing clause of claim 1. This means that the emergency shutdown and process safety system are integrated within a junction box having relays, semiconductor elements or the like, so that one electrical signal only is transferred further to the hydraulic or pneumatic part of the system. The hydraulic or pneumatic control valve is electrically operated and has, preferably, spring return. When the solenoid current is turned off the valve returns to the safe position, such that the actuator closes. By using the combined control circuit for the emergency shutdown and process safety system according to the invention, a simpler, cheaper, more maintenance-friendly and reliable panel is achieved. The Norwegian Petroleum Directorate's requirement that emergency shutdown systems must be completely independent on the process safety systems, is fully satisfied for any type of hydraulic or pneumatic valve.

In the following, the invention is further described with reference to the drawing, in which the single figure shows a schematic circuit diagram for a control circuit designed in accordance with the invention.

A combined control circuit is shown in the figure. A possible emergency shutdown signal is conducted in on a first control line 10 from an external circuit, not shown, for emergency shutdown, and is conducted through the first circuit branch 11 out on a common signal line 12. Between the emergency control line 10 and the signal line 12, a push button switch 13 and a relay-controlled switch 14 exist, placed in series between input and output of the circuit branch 11. Parallel to the push button switch 13, a relay-controlled switch 15 is placed, the coil 16 thereof is connected to the circuit branch 11 between the push button switch 13 and the relay switch 14.

A process safety/protection signal is conducted in on a control line 17 to another circuit branch 18. The circuit branch 18 has in series a push button switch 19 and a solenoid 20 controlling the switch 14.

Instead of the relays 14, 20 and 15, 16, semiconductor elements or similar elements may be used. The coupling has been carried out such that possible errors arising in the relays coil 20 interconnecting the two circuit branches 11 and 18, or errors within the process protection system, can not prevent emergency shutdown.

The signal line 12 is conducted to a control valve 21 operating the actuator 22 of a main valve 23. To drive the actuator 22, a hydraulic or pneumatic pressure source 24 exists. It may have a distributing system having local accumulators or a pressure tank. A return line 25 passes as a rule to free air in pneumatic systems, and back to tank in hydraulic systems.

## C l a i m s

1. A control circuit for controlling a combined emergency shutdown and process protection (safety) system, particularly on platforms, in refinery plants and on board crafts and vessels, where there are at least two separate control signal generators which, each by means of a control line (10, 17) of its own, can give release or control signals in order to operate a control valve (21) for the supply of hydraulic or pneumatic pressure medium, for operating a main valve (23), preferably by means of an actuator (22), wherein either one of the two control signal circuits should be operatable independently on the operating condition and possible error conditions in the other, in order to be capable at emergency shut down the main valve (23), c h a r a c t e r i z e d i n that it comprises at least two separate connection branches (11, 18) for connecting a first and a second control cable (10, 17) to a common control line (12) to the control valve (21), and that the other (18) of the two separate connection branches (11, 18) includes an activating member (20), such as a relay, for a switch (14) adapted to connect the first connection branch (11) to the outgoing control line (12), so that an input signal on the first connection branch is coupled as an output signal to the control line (12) when a voltage is applied to the activating member (20).

2. A control circuit as set forth in claim 1, c h a r a c t e r i z e d i n that the first connection branch (11) includes a switch (15) adapted to be opened when an emergency shutdown is being made.

3. A control circuit as set forth in claim 2, c h a r a c t e r i z e d i n that the switch (15) is operated by means of a relay or the like (16) coupled to the first connection branch (11).

4. A control circuit as set forth in claim 3, c h a r a c t e r i z e d i n that the switch (15) in the first connection branch (11) is connected in parallel to

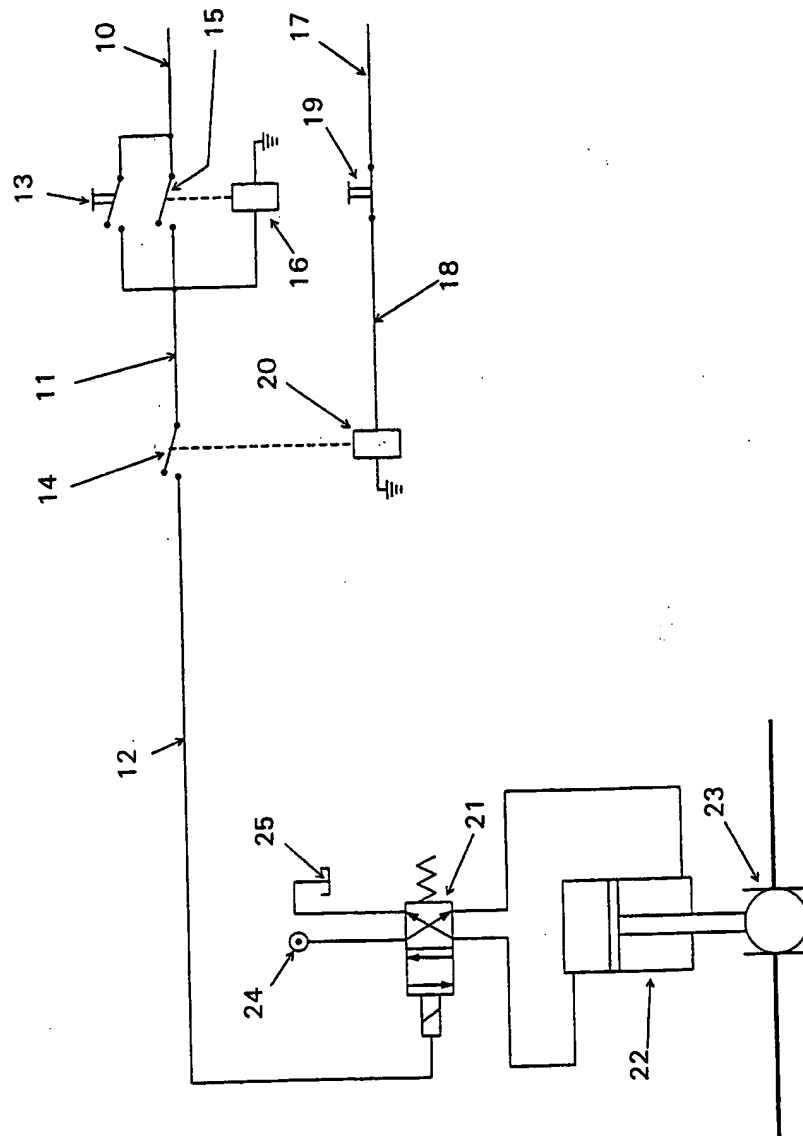
a push button switch (13) for restoring the connecting condition after an emergency disconnection.

5. A control circuit as set forth in one of the claims 1 - 4, characterized in that the control valve (21), as known per se, has spring-return for transfer to emergency stop position.

6. A control circuit as set forth in one of the claims 1 - 5, characterized in that the other (second) connection branch has included a manual switch (19) for opening current supply to the activating member (20), which gives current supply through the other connection branch.



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 95/00111

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F15B 20/00, G05B 9/02, F16K 31/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F15B, G05B, F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2262624 A (VICKERS SYSTEMS LIMITED), 23 June 1993 (23.06.93)	1-6
A	US 4445603 A (FILSINGER), 1 May 1984 (01.05.84)	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US-A- 4445603	01/05/84	DE-A, C, C 3034424	29/04/82
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